

# Mecheleciv



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THE GEORGE WASHINGTON UNIVERSITY

APRIL 1967



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You can help solve the world's fresh water shortage. You can help transform slums into beautiful new cities. You can help curb hunger.

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In all of our six operating groups\* we need bright young engineers and scientists to come to grips with today's and tomorrow's problems—now.

If you want to do something, talk to your Westinghouse recruiter when he visits your campus or write L. H. Noggle, Westinghouse Educational Center, Pittsburgh, Pa. 15221.

*An equal opportunity employer.*

\*The Westinghouse Operating Groups: Consumer Products; Industrial; Construction; Electronic Components & Specialty Products; Atomic Defense & Space; Electric Utilities.

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## SUDDENLY, IT'S UP TO YOU.

*Where has the time gone?* Suddenly (it seems) you're about to be a graduate engineer...faced with a career choice that is yours alone to make.

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**TAKE YOUR CHOICE...** of responsible and demanding assignments in such areas as: aerodynamics • human factors engineering • automatic controls • structures engineering • weight prediction • systems analysis • operations research • reliability/maintainability engineering • autonavigation systems • computer technology... and more.

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Please consult your College Placement Office for campus interview dates—or—for further information, write to Mr. Leo J. Shalvoy, Engineering Personnel.

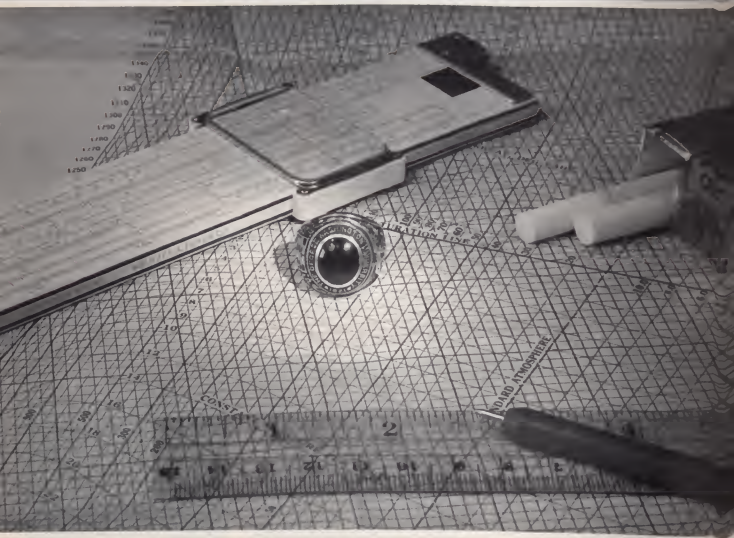
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# U A

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# MECHELECIV

## *FEEDBACK*

Feedback, as you know, is a reverse flow of an information signal that is used to control some associated process. Teaching is not a process that needs feedback, however it can be greatly improved if feedback is used properly.

When we look at teaching, we find that it is a process of give and take between the instructor and the student. There is no reason why a teacher should try to improve his lectures unless that is what the students want. There is no formal form of feedback other than examinations. These exams are few and far between, so the student must take the initiative to let the professor know how he can improve his lectures. This improvement is not in the subject matter since this is the professor's choice, but in the presentation of the subject matter.

There may be a lot of static in the feedback, but a good instructor can sort it out. After the student has produced the feedback, it is up to the instructor to see that it is used properly. At the prices we are paying for our education I should think that everyone could contribute some feedback.

--ASD

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**"Business is for  
the birds!"**

**Who says so?**

Lots of people do. Some right on your campus. And for rationale, they point an accusing finger at business and say it lacks "social commitment."

Social commitment? We wish they could visit our Kearny, N. J. plant, where we make cable and apparatus for your Bell telephone company. But we have time for other thoughts, other talents.

Like the situation in nearby Newark.

With civic and business leaders, we began buzzing with ideas. "Let's teach higher skills to some of the un-employed and under-employed. Say, machine shop practice. They could qualify for jobs that are going begging—and help themselves as well."

We lent our tool-and-die shop, evenings. We found volunteer instructors. A community group screened applicants. Another supplied hand tools. The Boys Club donated classroom facilities. Another company sent more instructors.

Some 70 trainees enrolled. Their incentive? Self-improvement. Results to date? New people at better jobs. Happier.

And this is only one of dozens of social-minded projects at Western Electric plants across the country, where our first job is making communications equipment for the Bell System.

So, you don't give up ideals when you graduate. If anything, at a company like, say, Western Electric, you add to them. And it's not just a theory. It's practice. Satisfying. Come on and find out. And watch a feathered cliché fly out the window.



**Western Electric**  
MANUFACTURING & SUPPLY UNIT OF THE BELL SYSTEM

# UFO'S: TWENTY YEARS OF



Man has been viewing aerial phenomena since Biblical times, but it is only within the last twenty years that he has evidenced any real interest in them. In 1947 the world was shocked by an Iowa man's report of nine strange objects which he said "flew like saucers would if you skipped them across the water." Although authorities attempted to minimize its importance by classifying the objects as mirages, the 1947 sighting gave rise to a storm of controversy that has lasted for twenty years.

"Flying saucer" spotting has become something of an international pastime. People are scanning the skies. The number of sightings varies from one season to the other and from one year to the next, but each time a new unidentified object is seen, the questioning and debating and speculating gain new momentum. From the scientist to the grocer on the corner, people want to know what these strange objects are. As the possibility of intelligent life on other planets gains wider acceptance, they wonder if these things really are the result of freakish interactions of atmospheric conditions or if they might be surveillance devices used by extraterrestrial beings. Many people find it odd that, despite the advanced technology of the Space Age, it has proved so difficult to determine the true nature of the UFO's.

The solution of the UFO enigma may not be long in coming, however. In October of 1966, the United States Air Force authorized a team of scientists at the University of Colorado to study the problem. The newly appointed group will investigate reports of UFO sightings and submit their findings to the AF authorities. It is hoped that this long overdue study -- the first really scientific approach since the "saucer era" be-

gan -- will soothe those who fear the United States government is hiding information to avoid causing a panic. Officials also hope the results of the Colorado team's work will determine once and for all whether UFO's are "scientific fact ... or science fiction."

The Air Force has chosen theoretical physicist Dr. Edward Uhler Condon to head this ambitious undertaking. The entire organization of the project and the dispensation of the funds allocated to it have been left to him. Thus far, Professor Condon and his aide Robert Low, former University of Colorado assistant dean and meteorologist, have completed an exhaustive questionnaire designed to elicit information with regard to color, luminosity, shape, motion, and smell of the UFO's sighted. Dr. Condon hopes that when the answers are processed by computer, a definite pattern will emerge; for example, similarities in weather conditions at the time of many of the sightings or recurring shapes and colors.

How the group plans to use its funds is not definite as yet. But Dr. Condon may invest part of it in camera equipment for police cars. The police are usually the first to arrive at the scene of an alleged sighting and their photographs could be of immense value.

The bulk of the information that will be used by the team will come from eyewitness accounts. Here Dr. Condon may encounter considerable difficulty. Psychologists will testify that human perception is extremely variable. People "instinctively fill out vague or briefly seen forms to make them more recognizable." In addition, they often confuse what was actually seen with what they think they have seen. Therefore, metallic-like becomes metal in the reports.

Although the vast majority of "strange" flying objects have been identified as such mundane things as weather balloons or distorted stars or aircraft, a number of reports have come from reliable, scientifically trained observers. Therefore, Dr. Condon refuses to scoff at the possibility that UFO's could be craft as yet unidentified by man or manifestations of extraterrestrial beings. Says he: "How can you calculate the probability of something when you don't even know anything about it?"

The current interest in UFO's dates back to a brilliantly clear, calm day in June 1947. Veteran pilot Kenneth Arnold was flying his own light aircraft from Chehalis to Yakima, Washington. He was about twenty-five miles from Mt. Rainier when he suddenly sighted nine peculiar objects flying in chain formation toward the peak. He watched, fascinated, as the objects

# CONJECTURE AND CONTROVERSY

Shari Partin

dipped and changed course every few seconds -- just enough for the sun to strike them at an angle and reflect brightly. He estimated that they covered the distance between Mt. Rainier and Mt. Adams -- some forty-seven miles -- in just one minute and forty-two seconds.

Arnold's account of his experience appeared the next day in newspapers throughout the world. The "Age of Flying Saucers" had begun.

In the twenty years that have elapsed since the first modern sighting, there have been literally thousands who claim they have seen UFO's of one sort and another. There have been more than 11,000 reports in the United States alone. The Air Force has done its best to investigate all of them, but they have been handicapped in their efforts by notoriety-seekers, cranks, hoaxers. Then, too, all their evidence is hearsay; the testimony of fallible human beings. Observers have submitted hundreds of photographs of alleged UFO's, but not one is detailed enough to permit any kind of positive identification.

On the basis of their investigations, Air Force officials feel that they have identified the majority of the UFO's sighted. Of the 11,003 spotted in this country, only 659 remain unidentified. The others have been explained easily and assigned to various categories:

Meteors, planets and stars, missiles, rockets, after-images, reflections, weather balloons, lights, birds, planes, fireworks, inversions, spot-lights, hoaxes, hallucinations, and satellites.

The 659 reports of UFO's which are still classified as unexplained will be the first to come under the scrutiny of the University of Colorado team. These include the now-famous incident at Exeter and the testimony of a New Mexico policeman who said he saw an egg-shaped object land and take off.

According to two patrolmen and several Exeter residents, "a huge, silent, brilliantly glowing object ... with red, pulsating lights," descended from the sky and "slowly encircled a house (turning) it bright red." The official Air Force report lists it as unidentified since no aircraft could "be placed in that area at that time."

The object that Lonnie Zamora of Socorro, New Mexico reported looked like an egg with "one end ... sort of tapered. It was white and smooth with no windows or openings of any kind." When Patrolmen Zamora originally spotted it, it was nestled in a gully, but within a few minutes it "flew off in a southerly direction," leaving only some singed mesquite behind.



Until now, the opinions of the experts and general public have been widely diverse. Dr. H. Allen Hynek, who for eighteen years was the chief consultant to the Air Force on UFO's, admits he is puzzled. In a resume of the situation presented to Congress last April, Hynek wondered why there are so few witnesses. Said he: "We should see a craft, if it actually exists as a tangible thing, we should see it go from point to point. This just doesn't seem to happen. There should be far more radar sightings (and, with all their observation) if these objects really existed as tangible objects ... astronomers would have seen more than they did." However, lest anyone dismiss UFO's as pure fantasy, Hynek added a word of caution: "All too often it has happened that matters of great value in science were overlooked because the new phenomena simply did not fit their accepted scientific outlook at the time. Thus, the evidence of fossils for biological evolution was overlooked, x-rays were overlooked..."

Major Donald Keyhoe, head of the National Investigation Committee on Aerial Phenomena (NICAP), maintains without reservations that "for the past 175 years the planet earth has been under systematic, close-range examination by living, intelligent beings from another planet."

At the opposite extreme is Dr. Donald H. Menzel of the Smithsonian Astrophysical Observatory at Cambridge, Massachusetts. Menzel is a learned scientist and has carried on his own investigations of UFO's. He believes that there is a natural explanation for all "flying saucers." "I do believe life exists elsewhere," he says, "but it has nothing to do with flying saucers. (They) are modern superstitions -- like dragons, ghosts, and sea monsters of yesterday -- that are nurtured by fear and uncertainty."

Who is right? Perhaps the team headed by Dr. Condon will provide us with the answers.



# ΘT RUNS A WINNER

The first part of the rally went smoothly. Cars started at one minute intervals. The men in Lucky #13 were so ready to go that they started without their route instructions. The first stop was at the end of the odometer check leg where odometer calibration factors were given.

Then came check point #1. All but six cars entered backwards, that is, from the wrong direction. Twenty-five points for that error and a lesson well learned. Check point #2 was thirty-five miles and many turns from #1, several turns too many for a few cars. The leg between check points #2 and #3 provided some excitement. Part of it was also being used by a rally club from the University of Maryland. Imagine the slapstick chase scene from the movie, "Mad, Mad World." Such was the activity there. Check point #4 was on a little-used government road near the finish line at Carderock Recreation Area.

All but three teams completed the course and met at the finish line for a picnic and to await the unofficial results. Trophies were awarded to winners in four classes: general, fraternity, sorority, and powder puff.

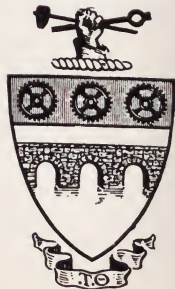
The enthusiastic participation in and success of this rally have led Theta Tau to plan another one for next fall. If you missed this one be sure to make the next one. Running a rally is an interesting and challenging way to spend a day.

Theta Tau, the professional fraternity in SEAS, improved its image as the active and able group in the Engineering School by sponsoring a successful auto rally on April 2. The event was given university-wide publicity and received enthusiastic support from students and faculty alike.

For those unacquainted with the term, a rally is a controlled time-speed distance contest of precision navigating. The object is to travel from start to finish over a course which is described by point to point instructions, maintaining specified average speed, and committing a minimum number of errors. Penalty points are assessed for such infractions as arriving late or early at check points, for entering check points from the wrong direction, and for missing a check point altogether. The contestant with the lowest score is the winner.

Theta Tau's rally was distinguished by the careful planning and organization that preceded it. The course itself had been selected 2 months in advance. The route instructions were drawn up and then checked again and again for clarity and correctness. A Porsche specially equipped for rallying was used to mark off distances to 0.01 mile and to establish running time between check points.

Rally day could not have been nicer, weatherwise, so a large crowd turned out, including several crews from American University and the University of Maryland. It would be hard to portray the typical team of driver and navigator. Several were very experienced in rallying and professional in their attention to detail. Some lacked experience but understood the basic mechanics of the sport. Others were the Sunday-driver type. Then there was Car #2, a Powder Puff entry, which when last heard from was somewhere in the vicinity of the Bureau of Standards.



# MECH MISS...



## JACKIE BANYASZ

As young and lovely as April itself, this month's Mech Miss is Jackie Bonyasz. Jackie is a 20 year old junior who hails from Garwood, New Jersey. Her interests include riding, softball, tennis and swimming.

At GW Jackie is majoring in French Education, is the School of Education's representative to the Student Council, and the first vice-president of Delta Gamma. After graduation Jackie plans to become an airline stewardess and then go into teaching.



# MECH MISS



# THE SHAFT



The National Bureau of Standards, which scientifically analyzes everything it gets its hands on, has just composed a tongue-in-cheek reference file card on woman:

Symbol: Wo; Atomic weight: 120. Occurrences: Found wherever a man is found, seldom in a free state.

Physical properties: Generally rounded in form. Boils at nothing and may freeze at any minute. Melts when treated properly. Very bitter if not used well.

Chemical properties: Very active. Possesses great affinity for gold, silver, platinum, and precious stones. Violent reactions when left alone. Able to absorb great amounts of food. Turns green when placed beside a prettier specimen. Ages rapidly.

Uses: Highly ornamental. Useful as a tonic in acceleration of low spirits, etc. Equalizes the distribution of wealth. Is probably the most powerful income-reducing agent known.

Caution: Highly explosive when in inexperienced hands.

\*\*\*\*\*

An engineer is a person who measures with a micrometer, marks with a piece of chalk, and cuts with a dull ax.

\*\*\*\*\*

A motorist was once driving in the country when suddenly his car stopped. He got out of the car and was checking

the spark plugs when an old horse trotted up the road.

"Better check the gas line," the horse said, and trotted on.

The motorist was so frightened that he ran to the nearest farm house and told the farmer what had happened.

"Was it an old horse with a flopping ear?" asked the farmer.

"Yes, yes!" cried the frightened man.

"Well, don't pay any attention to him," replied the farmer, he doesn't know a darn thing about cars!"

\*\*\*\*\*

"I've a friend I'd like you girls to meet."

Athletic girl: "What can he do?"

Chorus girl: "How much has he?"

Literary girl: "What does he read?"

Society girl: "Who are his family?"

Religious girl: "What church does he belong to?"

College girl: "Where is he?"

\*\*\*\*\*

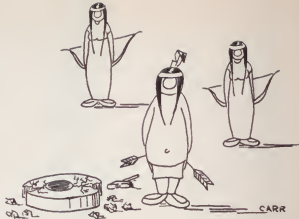
A man finally bought a parrot at an auction after some spirited bidding. "I suppose the bird talks," he said to the auctioneer.

"Talk?" was the reply. He's been bidding against you for the past half hour."

\*\*\*\*\*

# SHAFTED

## AGAIN



The teacher was quizzing the class.  
"Now who can tell me who gave us  
our nice schoolhouse?"

"President Johnson, teacher."

"That's right, Tommy. Who knows  
who gave us our beautiful parks?"

"President Johnson, teacher."

"That's right, Mary. And who gave  
us the birds and the bees and the flowers  
and the trees."

"God did, teacher."

Voice from the back of the room.

"Throw that Republican out of here."

\*\*\*\*\*

Four Marines were playing bridge  
in a hut on a South Pacific island during  
World War II. A sailor burst in shout-  
ing: "The enemy is landing a force of  
about 400 men on the beach."

The Marines regarded each other,  
wearily. Finally one said: "I'll go.  
I'm dummy this hand."

\*\*\*\*\*

Success is like a toy balloon sur-  
rounded by children armed with pins.

\*\*\*\*\*

"Young man," said the professor  
to the student who kept on interrupting,  
"are you trying to instruct this class?"

"Certainly not, sir," said the  
student. "Well, then, don't talk like  
an idiot."

\*\*\*\*\*

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\*\*\*\*\*

Student Nurse: "Isn't it funny  
that the length of a man's arm is just  
equal to the circumference of a girl's  
waist?"

E. E.: Let's get a piece of  
string and find out."

\*\*\*\*\*

The closest our civilization has  
to perpetual motion so far is street  
pairing.

\*\*\*\*\*

Message inside a Chinese fortune  
cookie: "Please disregard previous  
message."

\*\*\*\*\*

When a GI saw LBJ at the airport  
in Viet Nam, he couldn't believe his  
eyes. "Aren't you President Johnson?"  
he asked.

LBJ said, "Yes, I am."

"Man!" the GI exclaimed, "That's  
what I call a draft board!"

\*\*\*\*\*

# DR. FERRIS-PRABHU ATTENDS INTERNATIONAL SYMPOSIUM

*by Perry Saidman*



Leading scientists in the field of quantum theory from throughout the world participated in an international symposium last January which was dedicated to a University of Florida scientist. The symposium on "Atomic, Molecular and Solid-State Theory" was held at Sanibel Island, near the University of Florida, in honor of Dr. John C. Slater, world renowned pioneer in the quantum theory of matter.

Dr. A. Ferris-Prabhu, an Assistant Professor of Applied Science here at SEAS, was the only Washington area University scientist of those 200 present to attend the symposium, at which approximately 80 research papers were presented. Dr. Ferris-Prabhu was recipient of a National Science Foundation grant in order to attend the symposium.

Climaxing the Winter Institute in Quantum Chemistry, Solid-State Physics and Quantum Biology, the symposium permitted world-famous scientists to report on and discuss new research findings relating to the study of the structure of matter. Both the institute, held partly on the University of Florida campus and Sanibel Island, and the symposiums are arranged by the university in collaboration with the Uppsala Quantum Chemistry Group, Uppsala University, Sweden.

Dr. Slater has been scientifically active in his field for over 40 years and is considered by his colleagues as one of the outstanding scientists of the world. He has obtained some of the most significant research results in the quantum

study of matter and published more than 200 papers. He has written textbooks now in use throughout the world and formerly held a professorship at the Massachusetts Institute of Technology.

Dr. Ferris Prabhu, who holds a Ph.D. in Solid-State Physics and has a high regard for Dr. Slater, says about the symposium, "The great advantage of such a symposium is that it allows scientists from all over the world to get together and discuss any and all aspects of their work. The ample time and informal atmosphere provided permits a free exchange of ideas and discussions of matters of interest, actually enabling one attending to learn much more than he might if he attended a semester of lectures."

During the winter institute, scientists from the United States and abroad participate in intense lectures and discussions designed to provide them with a basic and broad understanding of research into matter through the quantum theory. The institute has brought international recognition and many leading scientists, including Dr. Robert S. Mulliken, University of Chicago scientist, who won the Nobel Prize for chemistry in 1966, to the University of Florida.

Although primarily a tool of pure research, quantum theory has been applied in the development of transistors and in 1966 provided information that may help laboratory scientists learn more about cell mutations, which many biologists believe are responsible for starting tumors.



THE CREW OF AN AIR CUSHION VEHICLE (ACV) inspects a sampan for possible contraband.

The air cushion vehicle (ACV) is a relatively new development in surface transportation which offers a tremendous flexibility of high-speed operation across water or rough terrain.

The ACV is one of a family of craft generally described as Surface Effect Ships which includes vehicles called Ground Effects Machines, Hovercraft, Flexible Skirt Craft, Peripheral Jets and Captured Air Bubble Craft.

They all operate on the same principle: Support in operation by a bubble or cushion of air. The varieties in the family of air cushion vehicles come mainly from the manner in which the air bubble is contained under the vehicle.

The expectation is large. The future is bright. The Institute for Defense Analysis, in a recent report on ACV's, stated: "The functional principle of air cushion vehicles appears to offer more potential for naval-military vehicles than

any other development during the past two centuries."

Current interest in the ACVs in the United States is being spearheaded by the Navy. In the new approach, the Navy sees the possibility of improving the speed of its antisubmarine warfare craft, its amphibious landing vehicles and its patrol and rescue craft. Looking into the future, the Navy envisions ACVs of 4000 tons capable of crossing the oceans at speed approaching 100 knots

This potential of ACVs comes from a characteristic which reduces dull drag through the water upon attainment of critical speeds. This drag reduction is drastic enough to permit speed increases beyond the critical point without additional power. The critical speed now is between 15 and 40 knots, depending on the hull design of the craft. Calculations indicate that an ACV with a critical speed of 40 knots could operate at above

Lawrence J. Kastner

100 knots without additional power requirements; in fact, once the critical speed is reached the power requirement actually drops in the 40-100 knot range.

ACV development in the U. S. is being carried forward by companies in the aerospace and ground transportation industries. Among the leading companies engaged in ACV projects are Bell Aerosystems, Boeing Company, Douglas Aircraft Company, Fairchild Hiller Corp., Lockheed Aircraft Corp., North American Aviation, Ford Motor Company, General Dynamics, and General Motors. One of the most active firms is Bell Aerosystems which has produced, with its own resources and with technical interchange and license agreement with a British firm, several ACVs.

In September 1966, Bell announced that it was building a production line and entering the commercial market in air cushion vehicles. The line produces versions of the ACVs which were deployed by the Navy to South Vietnam for pa-

trol duty in the Mekong Delta area as a counter to Viet Cong smuggling as well as those tested in ferry service among the San Francisco and Oakland International Airports and downtown San Francisco during 1965 and 1966. These tests used Bell's SK-5 model. The passenger version tested on San Francisco Bay had 18 seats. The new line will produce this version as well as 30 and 90-passenger models and cargo versions of the three sizes.

For civil application, Bell offers the ACV for use as fast passenger ferries, cargo carriers, police patrol craft, high speed ambulances, geological exploration craft and remote area transportation. Tests have shown that ACVs can move from over-water to over-land transportation with ease. This makes them particularly valuable in areas where the shoreline is a fringe of marsh, sand or other base which would prove difficult for ground-borne craft. Tests have also

--Continued on page 18





been run over the northern wastes of Canada where roads are non-existent and overland transportation is very difficult.

On the military side, the Navy has been active in the development of ACVs from the earliest stages. The three craft sent to Vietnam in May 1966 apparently performed very well. They were used in the Market Time Operation for control of smuggling. A Navy officer reported: "They can outrun anything on the river." The ACVs were very efficient in moving from assignment to assignment.

Because information on ACVs is limited today, the long-range applications are somewhat speculative. The Russians are aware of the potential, however. An article in the June 1966 issue of *Technology and Armament*, published in Moscow and written by an officer of the Russian Navy, notes that the ACV principle offers many advantages in antisubmarine warfare. The author points out that both surface and hydrofoil ships produce noise which is sufficient to expose

them to detection by submarines. "A better vessel," the article says, "is considered to be one capable of sailing without touching the water at all, i.e., an air cushion vehicle."

Pointing out that the air cushion vehicle would have a speed advantage over a submerged submarine, the article adds, "An air cushion patrol vessel would be able to carry modern anti-submarine weapons, to seek out the submarine and to maintain contact with it by aid of variable depth sonar equipment. It would have the advantage in all stages of submarine search and kill operations."

This conclusion is supported by Capt. M. J. Hanley, Jr., USN, in the *U. S. Naval Institute Proceedings*. Capt. Hanley states: "Possibilities for missions ... could include an ASW weapons system against possible missile submarines." Capt. Hanley is the Chief of Naval Operations' project officer for surface effects ships study at the Center of Naval Analysis. His article also notes that the ACVs may have applications in

minesweeping and amphibious warfare.

Detailed examination of these possibilities is not required to support the medium range future of ACVs in military applications. Current surface methods of transporting troops and equipment from ships to beaches is very slow, and thus vulnerable to beach defenses. The speeds possible in ACVs reduce the transit time and also the air cushion cuts vulnerability to mines or obstacles which plague surface craft.

Capability of the ACV to cross the water and land with relatively few problems in most areas also makes them ideal in amphibious warfare since they force the defender to protect much more area. Conventional craft of today are limited in their uses to areas where there is a reasonable beach over which equipment designed for land use can operate.

With ACVs, marshland would be no problem, nor would tide flats, for men and cargo could be transported over these surface craft obstacles far enough inland to reach solid ground.

Though military applications are in the forefront of ACV development today, commercial possibilities are not being ignored.

The Department of Commerce recently published a report on the possibilities of "Surface Effect Ships for Ocean Commerce." Called the SESOC report, the study concluded that huge ocean-going ACVs are a definite possibility. In general, the report indicated that development of satisfactory transoceanic ACVs must wait for additional information on stability modes; stability and control criteria; control systems; dynamic loads with respect to sea state; speed resistance, sea-keeping and structural requirements; overloading sea conditions; waves of unusual heights; damage and structural failure;

collision avoidance; and the need for better knowledge on how to maintain and improve the efficiency of the supporting bubble.

Points which will affect the development of economically competitive ACVs are development of highly efficient, high powered, lightweight propulsion systems capable of operation in the marine environment without maintenance problems; additional materials research and better weather prediction, according to the Commerce Department study.

The report addresses itself to the possibility of a 5000-ton transoceanic ACV and concludes that this is not a possibility within the next ten years unless a much higher level of effort is undertaken. The Navy, however, is now working on a proposed technical approach to the problem of getting five 500-ton research craft of various types within the next five to nine years. These craft would be prototypes of a possible 4000-ton ocean-going ship, Capt. Hanley reported in his article, and he adds: "It is within the realm of possibility that an accelerated research program could produce a 4000-ton SES in ten years."

Another possibility for ACV use suggested by Capt. Hanley is for use as aircraft carriers. Such ships would radically change concepts of carrier operation in that their speed would permit downwind launches, reduce vulnerability to torpedo attack in transit and cut the requirements for ASW escort.

A measure of the aerospace industry's involvement in the program and the know-how available is available from scanning the list of participants in the SESOC study. Personnel from General Electric, Lockheed, Martin, United Aircraft, Grumman, Bell, North American, General Dynamics, Northrop, Boeing and Aerojet General all contributed papers or staff studies to the Committee.

There is considerable effort being exerted today to bring the Navy's resources and those of the Department of Commerce together in the assault on the state of the art required to produce the big transoceanic ACVs.

The program should produce a vehicle of significant value to fast, efficient transportation.

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# CRYOGENICS: THE NEW FRONTIER

by Sethu Sekhar

Cryogenics is a term we engineering neophytes hear very often nowadays. For a long time, I wondered what it meant. I finally found the time not only to understand what it means, but also the fantastic variety of uses to which cryogenics has been put and the applications that will surely be exploited in the future.

The word cryo-genics means relating to cold, being derived from the Greek word "kryos" which means ice-cold and "genes" which means "born". The realm of cryogenics is usually defined as the temperature range below  $-100^{\circ}\text{C}$ , extending down to absolute zero,  $-273^{\circ}\text{C}$ . (Lord Kelvin established in 1848 that it is impossible to achieve a temperature below absolute zero.) This is the realm where gases of the air turn liquid, where steel becomes brittle as glass, where metals become super-conductive, and where living cells pass into a state of suspended animation.

The cryogenic gases are those gases whose boiling points are below  $-100^{\circ}\text{C}$ . The four which are available in the greatest quantities are oxygen, nitrogen, helium and hydrogen. Oxygen liquefies at  $-183^{\circ}\text{C}$  while helium, useful in the very low temperature range, liquefies at  $-269^{\circ}\text{C}$ , only  $4^{\circ}\text{C}$  above absolute zero. Most air-separation plants of the present day use separation of the air at controlled cryogenic temperatures.

It is perhaps logical that a substantial portion of this essay should be devoted to the major uses to which cryogenics has been put.

Space Research is a major consumer of the cryogenic fluids, using oxygen as a chemical reactant, hydrogen both as a chemical fuel and also as a working medium for nuclear rockets, nitrogen for precooling, flushing and cold flow testing of rockets on the test stands and for cooling of space simulator chambers, and helium for cryopumping of the chambers. Liquid propellants are used in most major missiles. In the Gemini space vehicle, cryogenic fuel cells are employed in which both the hydrogen and the oxygen are liquids.

The use of the prefix 'cryo' has become quite extensive. So it is not surprising to find a mushrooming field called cryobiology. This is a study of life in relation to cold. The storage of semen at cryogenic temperatures and the artificial insemination of cattle is a commercial practice. Liquid nitrogen is used in the treatment of skin disease. Blood preservation by freezing is undergoing extensive clinical tests. The banking of human organs at liquid nitrogen

temperature as spare parts in surgery is a hope for tomorrow. Experts have even suggested the possibility of transporting a human being on a long space voyage in a state of frozen suspended animation so that he may arrive at his destination decades after blast-off as young as the day he departed. Cryosurgery is used in the alleviation of Parkinson's disease; here, the area in the brain where the tremors originate is frozen at about  $-40^{\circ}\text{C}$  and thus destroyed.

It is not necessary to point out the importance of cryogenics in food handling because of the food consumed in the United States, about 35% is refrigerated by cryogenic means.

In electronics, cryogenics has found a honorable place for itself because at low temperatures, noise is reduced substantially. The low-temperature operation of maser crystals is a necessity so that thermal vibration of the atoms do not interfere with the adsorption emission of microwave energy. Cryogenic cooling yields much greater output in lasers and increases the sensitivity of infra-red devices used in tracking down airplanes and missiles.

The electrical conductivity of some metals seems to vanish altogether near absolute zero. This phenomenon is called superconductivity. It is used in cryogenic magnets where the current circulates endlessly and the magnetic field is perpetually available. Superconductive motors have been designed. These are special motors which are free of internal electrical and mechanical losses. They contain rotors which float in liquid helium, helium gas, or high vacuum, being supported by a cushion of magnetic flux set up by the superconducting stator coils.

It won't be long before cryogenic computers will be on the market. Using tiny superconducting switches, the new computers use thousands of bits of metal deposited in microscopic amounts on thin films to achieve switching speeds 50 times attained by the fastest transistor. In addition to the speed, such a computer will also have a very large memory in a compact space.

Superfluidity is another phenomenon that must be mentioned in passing. It is exhibited by helium cooled below  $2.2^{\circ}\text{K}$ . At such temperatures, there seems to be no viscosity at all. A thin film of liquid will climb up the walls of the container in apparent defiance of the law of gravitation.

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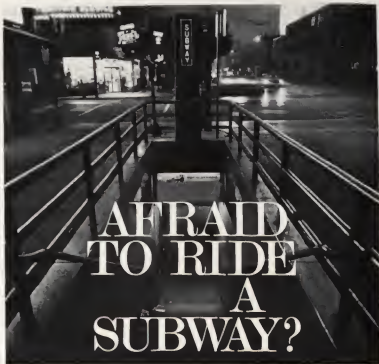
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